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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/726,788	12/02/2003	Hong-Soo Kim	4591-357	6111

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EXAMINER

WILSON, CHRISTIAN D

ART UNIT PAPER NUMBER

2891

DATE MAILED: 04/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

SM

Office Action Summary

Application No.

10/726,788

Applicant(s)

KIM ET AL.

Examiner

Christian Wilson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>01032005</u> . | 6) <input checked="" type="checkbox"/> Other: <u>search history</u> . |

DETAILED ACTION

Claim Objections

1. Claim 14 is objected to because of the following informalities: claims 14 depends from claim 14. Appropriate correction is required. For purposes of examination, the examiner assumes that claim 14 depends from claim 13.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 11 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
4. Claim 11 recites the limitation "assistant trench" in line 9. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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6. Claims 1 – 5 and 8 – 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Brown *et al.*

Brown *et al.* (US 6,144,086) discloses a method of forming a semiconductor device comprising the steps of providing a semiconductor substrate 10, forming an upper trench 20 at a predetermined region of the substrate and a bottom trench 16 at a bottom surface of the upper trench where the upper trench has a larger width than the bottom trench, and forming a field oxide 24 filling the trenches.

Regarding claim 2, Brown *et al.* further discloses forming an assistant trench 16 at a predetermined region [Figure 1], forming a trench mask layer 14 on the substrate, forming an opening exposing the assistant trench and predetermined region of the substrate at both sides of the assistant trench by patterning the trench mask layer [Figure 3], forming the upper trench and bottom trench by anisotropically etching the exposed bottom surface of the assistant trench and substrate [Figure 4], where the upper trench has the same width as the opening and the bottom trench has the same trench as the assistant trench [Figure 4].

Regarding claim 3, Brown *et al.* further discloses forming a channel stop region 18 where the bottom trench is in contact with the channel stop region [Figure 5].

Regarding claim 4, Brown *et al.* further discloses an assistant trench with the same width as the channel stop region [Figure 2].

Regarding claim 5, Brown *et al.* further discloses forming an assistant trench mask layer 14 on the substrate, forming an assistant trench opening exposing a predetermined region of the substrate by patterning the assistant trench mask [Figure 1], forming an assistant trench by

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selectively etching the substrate [Figure 1], forming a channel stop region by ion implantation [Figure 2], and removing the trench mask layer [column 3, lines 55-57].

Regarding claim 8, Brown *et al.* further discloses forming a field insulator filling the upper and bottom trench [Figure 5], planarizing the field insulator, and removing the trench mask layer [column 4, lines 10-15].

Regarding claim 9, Brown *et al.* further discloses forming an upper trench 20 and forming a bottom trench 16 by selectively etching the bottom of the upper trench.

Regarding claim 10, Brown *et al.* further discloses forming a channel stop region 18.

Regarding claim 11, Brown *et al.* further discloses an assistant trench with the same width as the channel stop region [Figure 2].

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown *et al.* in view of Ohno.

Brown *et al.* discloses the limitations of claim 3 as described above, but does not describe an assistant trench which is wider than the channel stop region and forming the channel stop region by using an ion implantation mask formed in the assistant trench. Ohno (US 6,586,295) teaches a doping method where the doped region is narrower than the trench width and is formed

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by depositing and patterning a mask layer with the trench [Figure 1D]. It would have been obvious to one of ordinary skill in the art to use the method of Ohno in the method of Brown *et al.* since this method prevents unwanted contact between the doped region and the source/drain regions near the surface of the substrate [column 6, lines 15-25].

9. Claims 12 – 16 and 19 – 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown *et al.* in view of Bohr.

Regarding claim 12, Brown *et al.* teaches a method of forming a semiconductor device comprising the steps of providing a semiconductor substrate 10, forming an upper trench 20 at a predetermined region of the substrate and a bottom trench 16 at a bottom surface of the upper trench where the upper trench has a larger width than the bottom trench, and forming a field oxide 24 filling the trenches. Brown *et al.* does not discuss forming a second trench in a first region of the substrate. Bohr (US 5,536,675) teaches forming a first trench in a first region where the first trench and the upper trench have identical depths [Figure 2]. It would have been obvious to one of ordinary skill in the art to form the first trench of Bohr in the method of Brown *et al.* since the method of Bohr provides a simplified process for forming both shallow and deep isolation trenches [column 3, lines 1-10].

Regarding claim 13, Brown *et al.* further teaches forming an assistant trench 16 at a predetermined region [Figure 1], forming a trench mask layer 14 on the substrate, forming an opening exposing the assistant trench and predetermined region of the substrate at both sides of the assistant trench by patterning the trench mask layer [Figure 3], forming the upper trench and bottom trench by anisotropically etching the exposed bottom surface of the assistant trench and

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substrate [Figure 4], where the upper trench has the same width as the opening and the bottom trench has the same trench as the assistant trench [Figure 4].

Regarding claim 14, Brown *et al.* further teaches forming a channel stop region 18 where the bottom trench is in contact with the channel stop region [Figure 5].

Regarding claim 15, Brown *et al.* further teaches an assistant trench with the same width as the channel stop region [Figure 2].

Regarding claim 16, Brown *et al.* further teaches forming an assistant trench mask layer 14 on the substrate, forming an assistant trench opening exposing a predetermined region of the substrate by patterning the assistant trench mask [Figure 1], forming an assistant trench by selectively etching the substrate [Figure 1], forming a channel stop region by ion implantation [Figure 2], and removing the trench mask layer [column 3, lines 55-57].

Regarding claim 19, Brown *et al.* further teaches forming an upper trench 20 and forming a bottom trench 16 by selectively etching the bottom of the upper trench.

Regarding claim 20, Brown *et al.* further teaches forming a channel stop region 18.

Regarding claim 21, Brown *et al.* further teaches an assistant trench with the same width as the channel stop region [Figure 2].

10. Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown *et al.* and Bohr as applied to claim 14 above, and further in view of Ohno.

Brown *et al.* as modified by Bohr teaches the limitations of claim 14 as described above, but does not describe an assistant trench which is wider than the channel stop region and forming the channel stop region by using an ion implantation mask formed in the assistant trench. Ohno (US 6,586,295) teaches a doping method where the doped region is narrower than the trench

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width and is formed by depositing and patterning a mask layer with the trench [Figure 1D]. It would have been obvious to one of ordinary skill in the art to use the method of Ohno in the method of Brown *et al.* since this method prevents unwanted contact between the doped region and the source/drain regions near the surface of the substrate [column 6, lines 15-25].

11. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brown *et al.* in view of Bohr and Lee *et al.*

Brown *et al.* teaches a method of forming a semiconductor device comprising the steps of providing a semiconductor substrate **10**, forming an upper trench **20** at a predetermined region of the substrate and a bottom trench **16** at a bottom surface of the upper trench where the upper trench has a larger width than the bottom trench, and forming a field oxide **24** filling the trenches. Brown *et al.* does not discuss forming a second trench in a first region of the substrate or forming a key trench in a key region. Bohr teaches forming a first trench in a first region where the first trench and the upper trench have identical depths [Figure 2]. Lee *et al.* (US 5,252,510) teaches forming a key trench **15** in a key region of the substrate **15A**. It would have been obvious to one of ordinary skill in the art to form the first trench of Bohr and the key trench of Lee *et al.* in the method of Brown *et al.* since the method of Bohr provides a simplified process for forming both shallow and deep isolation trenches [column 3, lines 1-10], and the key trench of Lee *et al.* provides a means of aligning further implantation steps.

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Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The cited prior art teaches methods of forming dual width STI structures with channel stop implantation.

13. A copy of the EAST search history is enclosed.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christian Wilson whose telephone number is (571) 272-1886.

The examiner can normally be reached on weekdays, 7:30 AM to 4 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Christian Wilson, Ph.D.
Primary Examiner
Art Unit 2891

CDW